stated, of *Calocampa exoleta*, &c., to sticks, is intended. One is at a loss to understand why some ancestral time at which Haase imagined that food was especially scarce, and the enemies of insects especially keen, should be spoken of as a "Palæolithic Period" (p. 118).

At the end of the volume the author contributes a section, entitled "Mimicry a form of protective adaptation to the environment" (pp. 145-151). In these pages he treats, in a very inadequate manner, of protective resemblances in general. The important and widespread cases of variable colour resemblances he does not even mention. The attempt is made to distinguish between protective resemblance and mimicry on the ground that the latter is an imitation of moving objects, the former of motionless ones. This distinction, which has been drawn before, seems to the present writer to be unreal, and, so far as it holds, to be of little importance as a basis for classification. There are many examples of the protective resemblance of moving objects—butterflies and moths which resemble leaves whirled along by the wind; larvæ and cocoons which resemble sticks, &c., swinging by a thread. The essential distinction lies in the fact that in protective resemblance the model is of no interest to the enemies of the imitator, while in protective mimicry the model is dreaded or disliked by the enemies; the effect of protective resemblance is concealment; the effect of protective mimicry, conspicuousness.

In this section the wonderful resemblance of butterflies of the genus *Kallima* to dead leaves is briefly discussed, and the author concludes (p. 147) that

> "the extraordinarily manifold variations among *Kallima*, &c., show, not only that these so perfect resemblances of withered leaves, and often of those covered with rust-fungus or partially eaten by larvæ of *Agromyza*, are the highest development of mimicry of leaves, but they also indicate that these are the youngest forms, and are still under the influence of natural selection, which will gradually obliterate that which is less fitting."

It is, of course, very improbable that a species which has attained the highest development in any character could still remain in the formative stage as regards the very same character. As a matter of fact, the "extraordinarily manifold variations" of *Kallima* are not the ordinary individual differences upon which natural selection acts, but rather certain varied forms into which the species has been thrown by natural selection, causing it to resemble not one, but many of the appearances presented by dead leaves, and thus conducing towards its protection. This high product of selective action has been mistaken by Haase for the mere material for selection to begin its work upon.

There are some excellent pieces of work and interesting suggestive inferences to be found in the memoir—not to be compared to the great hypotheses connected with the names of Bates, Wallace, and Fritz Müller, but valuable additions to the subordinate parts and details of the subject.

Of this kind is the discussion on mimicry in the *Papilioninæ* (pp. 80-95), to which Haase has given special attention, and which forms the subject of Part i. of his work, as yet untranslated into English. In this section he produces evidence that the species of *Papilio* which are especially mimicked by others belong to the genus *Pharmacophagus*, and, as he thinks, derive their qualities from the poisonous or acrid larval food.

The contention (p. 97) that specially protected butterflies but rarely avail themselves of a distinct and markedly conspicuous "warning colour," that "among the *Neotropinæ* in general the wing-colouring, with its brilliant yellow, rusty-brown and black, is more beautiful than unpleasant," must be admitted to be true; the conclusion was, in fact, stated in 1890 by the present writer, who also pointed out that a conspicuous appearance is nevertheless attained because "the colours spread on the parts which are exposed during rest, and the flight becomes sluggish, so that they are displayed as completely as possible" ("Colours of Animals," Lond., 1890, p. 191).

On p. 106 we meet with an interesting case (that of four white spots on the outer margin of the hind wing of the female var. *protogenia* of *Elymnias undularis*, Dru.), in which it is argued with force that changes caused by reversion to an older type of marking have been made use of to aid a mimetic resemblance. In a note on the same page, Haase brings forward *Cethosia cyane*, Dru., as a unique example of a closer resemblance on the part of the male than the female to another specially defended insect—*Danais chrysippus*. He makes the very probable suggestion that the *Cethosia* is also itself specially defended.

Interspersed with much almost worthless speculation there is a great deal that is suggestive and valuable in the analysis of the various patterns of those *Neotropinæ* which are resembled by other butterflies, including many belonging to different sections of the group itself (pp. 116, 117). The various tables embody an immense amount of careful comparison and the examination of a vast number of specimens; they will prove of the highest value to future workers. E. B. P.

(*To be continued.*)

A DEVONSHIRE GEOLOGIST.

A Memoir of William Pengelly, of Torquay, F.R.S., Geologist, with a Selection from his Correspondence. Edited by his daughter, Hester Pengelly. With a summary of his scientific work, by the Rev. Prof. Bonney, F.R.S. 8vo. Pp. xi + 341; with portrait and 10 illustrations. (London: John Murray, 1897.)

THE story of William Pengelly is one of the pursuit of knowledge under difficulties, and of the achievement by the hero of an honoured place amongst those who have rendered distinguished service to science. Many of his paternal ancestors were sailors, and his father was captain of a small coasting vessel, in which his son William accompanied him, after receiving an elementary education at East Looe in Cornwall. For four years the lad was engaged in a seafaring life, but in 1828, at the age of sixteen, and at the earnest desire of his mother, he returned to his native village, and was occupied for a few years in active manual labour. He had, however, developed a passion for learning, and every hour that could be spared, was devoted to the acquisition of knowledge, and more especially of mathematics. Having so far prepared himself, after severe study and under great privations, for more congenial labours, he removed to Torquay and opened a small day-school. Here he met with good success, which rapidly increased as the years passed by.

His earliest geological lesson had been learned at Lyme Regis when, as a sailor boy, he had been weather-bound on the Dorset coast, and had observed a fine ammonite. Later on the reading of a chapter on geology in a work published by the brothers Chambers, gave him his first insight into the objects of the science, and led him to devote attention to the subject. Thus, when he went to London in 1843, he was interested in visiting the British Museum, the Royal College of Surgeons, and the Museum of Economic Geology (as it was then called) at Craig's Court. He had some difficulty in finding the last-named museum.

Torquay has always been a locality of great interest to the geologist, and when Pengelly commenced his labours it was not long after the founding of the Devonian system by Sedgwick and Murchison, aided by Lonsdale. Moreover, De la Beche and Godwin-Austen had published their important researches on South Devon, and McEnery had brought into notice the interest attaching to the local bone-caves. No wonder that Pengelly, when once his ardour had been kindled, started to explore the district with vigour and enthusiasm.

Many little adventures and anecdotes are recorded with reference to his geological expeditions. On one occasion at a wayside inn, where he had taken a seat on the kitchen settle, Pengelly answered some inquiries addressed to him by three labourers, and finally entertained them to such good effect on the subject of stone-breaking, that the landlord became keenly interested. Seeking an interview next morning with Pengelly, he thus expressed himself:

> "I hope no offence, sir: but ef you'd stop 'ere for a foo days, or a week, and talk to the men in the evenin's, you shud be welcome to meat, drink, washing, and lodging free gratis. I'm sure lots o' men wud come an' hear 'ee, and I should zell an uncommon zight o' beer."

In 1855 Pengelly went, for the first time in London, to an evening meeting of the Geological Society. In a letter to his wife he says:

> "There were probably about forty persons present, which I believe is considered a good attendance. We were rather late, and found on our arrival that a paper was being read descriptive of Mauna Loa, the volcano in Owhyhee. At its close, Austen, a well-known geologist, and who once lived at East Ogwell, read a paper on the 'Probability of coal existing at workable depths near London.' . . . A discussion followed the paper, in which the author was by no means spared, as the various speakers expressed themselves freely."

What seems remarkable to us is the small attendance at the reading of this important paper by Godwin-Austen, and the fact that it was given second place at the meeting! Next year Pengelly attended another meeting of the Geological Society, when papers were read by Carrick Moore and Babbage. He says, "It was a magnificent meeting, and made me wish for a town residence."

Pengelly first attended the British Association in 1856, at Cheltenham, and he was present at all subsequent meetings up to 1889, with the exception of that held at Montreal in 1884.

In 1858 his detailed researches on the caverns of Devonshire may be said to have commenced. In that year the Brixham Bone-cavern was discovered, and the investigation was undertaken by the Royal and Geological Societies; a committee being appointed by the latter body, and the exploration being placed under the superintendence of Mr. (afterwards Sir Joseph) Prestwich and Mr. Pengelly. The bulk of the work naturally fell to Pengelly. It was long before the results of this investigation were issued. The delay, indeed, was aggravating, for it was not until 1873 that the full account was published.

Meanwhile Pengelly became engaged in a systematic examination of the lignites and clays of Bovey Tracey, in conjunction with Dr. Oswald Heer, who undertook the determination of the plant-remains. This important work was executed at the expense of the Baroness Burdett-Coutts, and the results were published in 1862. The age of the deposit was regarded by Heer as Miocene, but it has since been shown by Mr. Starkie Gardner to be Eocene.

In 1864 the first steps were taken to secure a systematic exploration of Kent's Hole, Torquay; and, aided by grants from the British Association, the work was carried out by Pengelly, who for more than fifteen years devoted himself with never-flagging energy to the task. During these years he annually reported progress at the meetings of the British Association, and his discourses on these occasions formed an attractive feature in the proceedings of Section C. Here, as elsewhere in all his lectures, he contrived to blend his science with a considerable amount of humour, while his expositions were both clear and spirited.

With regard to the exploration of Kent's Hole, Prof. Bonney rightly observes that "it was the most complete and systematic investigation of a cavern which had ever been undertaken." The time and labour, the care and patience, exhibited by Pengelly, and the precision with which he noted every fact, were extraordinary, but thoroughly characteristic of the man. His very full reports will ever remain as a monument of these labours. He had intended to publish a separate book on Kent's Cavern; but, considering that all particulars have been given in his many papers, the abandonment of this task need not seriously be regretted.

This outline of his principal work affords but a meagre idea of the activity of the man. He not only spent a good deal of time in lecturing in many provincial towns, but devoted much energy to local institutions in Torquay. The organic remains from various formations in Devonshire were eagerly sought for, and a fine collection of Devonian fossils which he had gathered together was presented to the Oxford Museum by the Baroness Burdett-Coutts in 1860.

His main efforts were always directed to the geological questions relating to Devon and Cornwall. He was master of all the literature, and many of his contributions were most useful summaries of knowledge on particular subjects. Curiously enough, but little is said in this volume of his fellow-workers in Devonshire. Dr. Harvey B. Holl, who, after Godwin-Austen, published a detailed account of the geology of South Devon, is not mentioned. Nor is much said of G. W. Ormerod nor of A. Champernowne, the latter of whom had laboured more assiduously than any previous worker at the intimate structure of parts of South Devon. More frequent references are made to William Vicary, who happily survives, and whose grand collection has done so much to illustrate the life-history of the rocks of Devonshire; and there are several references to John Edward Lee, though not to his collection of Devonian fossils, perhaps the finest of its kind as regards South Devon. Such omissions may not be deemed of great importance, but to one not familiar with the subject the book is apt to convey the notion that Pengelly was almost the sole worker, in his time, on Devonshire geology.

A great portion of the volume is taken up with letters from Pengelly to various members of his family, giving interesting accounts of his journeys and lectures, and of the many men of science and others whom he met; and there are numerous extracts from letters of Lyell and others addressed to Pengelly. The fame of Kent's Cavern brought many an illustrious visitor to Torquay, and although Pengelly's time was a good deal taken up in describing the cavern and its contents, he was naturally gratified at the interest manifested. In society he was always a genial companion, full of fun, and notoriously full of puns; so much so indeed that in 1862, at the first meeting of the Devonshire Association, which he was mainly instrumental in founding, he was christened Mr. *Pun*gelly by the President, Sir John Bowring.

Prof. Bonney, in a concluding chapter, has given a capital account of the scientific work of Pengelly; and appended to it is a list of his papers, apparently compiled from the Royal Society "Catalogue of Scientific Papers." Unfortunately these are not enumerated in strict chronological order, nor is the list complete. It would have been well to make it so, for it would have been an appropriate record of Pengelly's many-sided labours. One of his elaborate papers, published in the *Transactions* of the Devonshire Association (vol. v.), dealt with "The signs of the hotels, taverns, inns, wine and spirit vaults, and beershops in Devonshire"—a subject that should not be without interest to the field-geologist.

Those who were personally acquainted with Mr. Pengelly will read this work with especial interest, including the accounts of many minor circumstances that otherwise may appear somewhat trivial and unnecessary. When, however, we remember that the work has been edited by the loving hand of a daughter, we may well pardon any excess of zeal, and thank her for having given so excellent a biography of one who laboured manfully, enthusiastically, and successfully in the cause of science.

H. B. W.

MEXICAN ARCHÆOLOGY.

Archeological Studies among the Ancient Cities of Mexico. Part ii. By W. H. Holmes. Pp. 200. (Chicago, 1897.)

THE second part of Mr. Holmes' work on the ancient cities of Mexico has this year appeared, and completes the first part of a series of anthropological publications to be produced under the auspices of the Field Columbian Museum at Chicago. This work, extending as it does to over 300 pp. and containing numerous plans, sketch-maps, drawings and photographic reproductions, has been conceived on a somewhat more ambitious scale than previous publications of the Field Columbian Museum. It is evident at a glance that the greatest pains have been taken in the preparation of the plans and drawings, while the numerous papers Mr. Holmes has already contributed to various scientific journals are a sufficient guarantee of his competence to undertake a survey of one or more of the cities of ancient Mexico. In this field of archæological research there are already many patient workers who devote much time to the excavation and survey of the ruins, but there is no lack of material for study, and many sites still remain comparatively untouched. We must admit, however, that the two parts before us are a little disappointing. From the obvious care expended on them we were prepared to welcome them as a contribution of the first importance to Mexican archæology, but on perusal they do not quite justify our expectations. Let us hasten to add that this is due to no fault of the author, but is a necessary consequence of the plan and nature of the expedition of which the volumes are a record.

Mr. Holmes' studies among these ancient sites were undertaken in the spring of 1895, when he spent three months travelling in these regions with Mr. A. V. Armour, of Chicago, and other friends. Botany, geology, anthropology and natural history were impartially studied by the party, and, as Mr. Holmes remarks in his preface, he himself as "Curator of Anthropology" in the Field Columbian Museum, "was expected to examine and describe such archeologic remains as happened to be encountered during the journey." It must not, however, be supposed that the book is merely the record of a pleasure trip. The localities visited are dealt with systematically, but in every case too little time was given to the examination and measurement of the ruins. The first part of the trip was devoted to the monuments of Yucatan, when the islands of Contoy, Mugeres, Cancun and Cozumel, and the mainland opposite them, were examined in less than two weeks, during which period the party went as far south as Tuloom, where they did not land, but Mr. Holmes sketched the ruins from the sea. In the interior of Yucatan the remains at Tikul, Uxmal, Izamal and Chichen-Itza were also examined in less than a fortnight. The first part of the book dealt with these places, but it will be obvious that so little time having been spent at the actual ruins, Mr. Holmes' notes were necessarily superficial. He thereby lays himself open to correction by more systematic explorers than himself, and, as a matter of fact, Mr. Alfred P. Maudslay, who in 1889 encamped for five months at Chichen-Itza, which Mr. Holmes and his party in 1895 did in a week, has already pointed out in the columns of NATURE (vol. liv. pp. 274 *ff.*) several inaccuracies in his observations. The second part of the work, which has just appeared, deals with the monuments of Chiapas, Oaxaca, and the Valley of Mexico, and though larger in bulk than its predecessor, represents the result of observations made in an even shorter period, four days being spent on the ruins of Palenque, a week at Mitla, a day on Monte Alban, while from Mexico two brief excursions were made to San